Contribution ID: **143** Type: **Parallel Presentation**

Sensor co-design for Smartpixels

Thursday, November 21, 2024 11:15 AM (15 minutes)

As upcoming high energy physics experiments move towards higher energies and luminosities, there is a strong need to improve the measurement precision of tracking detectors. High-granularity pixel detectors are a feasible option and would enhance high-priority physics, especially signatures with heavy quark decays, but with the added cost of increased data rates. The objective of the Smartpixels project is to reduce the associated data volumes and unlock new capabilities by implementing neural networks on the detector hardware. To achieve this, we must understand the interdependence of algorithm and detector so that we can co-design them optimally. Previous work used filtering networks in the readout chips to predict the transverse momentum (pT) of incident particles and remove unimportant tracks with low pT. This work demonstrated signal efficiency and background rejection of about 93% and 25%, respectively, in simulation. The study has now expanded to assess network performance across various device parameters and test regression networks for predicting hit position and incident angle. This talk will cover ongoing work exploring how the pixel sensor pitch, radiation damage, and Lorentz drift (or its absence) affect the performance of the networks.

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Session Classification: RDC 03 - Solid State Tracking Parallel Session

Track Classification: RDC Parallel Sessions: RDC3: Solid State Tracking